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IN RE FTC REQUEST FOR COMMENTS ON POSSIBLE
MODIFICATIONS TO THE PRESENT CIGARETTE
TESTING METHODOLOGY

COMMENTS OF LIGGETT & MYERS TOBACCO COMPANY, INC.

June 30, 1983

PATTON, BOGGS & BLOW

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TABLE OF CONTENTS

Comments.....Tab A

Expert Consultants' Report.....Tab B

Curriculum Vitae of Dr. Gabriel L. Plaa.....Tab C

Curriculum Vitae of Dr. David L. Westfall.....Tab D

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Emily H. Rock
Secretary
Federal Trade Commission
6th & Pennsylvania Avenue, N.W.
Washington, D.C. 20580

Re: Request for Comments on Possible Modifications to the Present FTC Cigarette Testing Methodology

Dear Ms. Rock:

I. Introduction

On behalf of our client, Liggett & Myers Tobacco Company, Inc. ("Liggett"), we are responding to the Federal Trade Commission's ("FTC") request for comments regarding possible changes in the FTC testing methodology for cigarettes. Liggett is the smallest of the major United States manufacturers of cigarettes, but it has been a major catalyst for innovation and increased competition in the cigarette industry -- an industry which most observers would conclude is dominated by two firms: Philip Morris, Inc. ("Philip Morris") and R.J. Reynolds Tobacco Company ("Reynolds"). One of Liggett's most important and recent competitive innovations has been the successful introduction of generic cigarettes.

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Liggett sincerely believes that any change in the present FTC testing methodology will jeopardize its competitive position and could have a very severe impact on Liggett's efforts to gain consumer acceptance of generic cigarettes. Liggett simply cannot afford the significant and unknown additional costs that will result from a modification of the testing procedures. But perhaps of even greater significance, the best scientific evidence available, including independent analysis commissioned by Liggett, demonstrates that the current test reliably ranks cigarettes according to tar and nicotine content. This is all that can be reasonably expected from a standardized test. Thus, there is no scientifically justifiable reason for altering the existing test.

Even assuming, arguendo, that the current FTC test has some imperfections -- as any standardized test will when applied to particular brands -- none of the FTC's proposed "remedies" would be in the public interest. Each of the "remedies" would create new problems for consumers which would outweigh any possible benefits. Accordingly, as will be elaborated upon in these comments, the current FTC test should not be altered, and if it is altered, it should not be altered in any of the ways suggested by the FTC.

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II. The Existing FTC Testing Methodology Accurately Ranks Cigarettes According to Tar and Nicotine.

In assessing the adequacy of the existing testing methodology, the FTC must not lose sight of the purpose of the test. The purpose of the test is not, and never has been, to duplicate individual smoking behavior. As the FTC recognized when it first adopted the current testing methodology, "There is no human smoker who smokes, and no cigarette that is smoked, under conditions that precisely duplicate either the Cambridge Filter Method in its original form or as modified by the Commission." Federal Trade Commission "Statement of Considerations" (1967). A number of different variables affect actual tar and nicotine intake by an individual smoker, and these variables change from smoker to smoker. The variables include the number of cigarettes smoked, puff volume, puff frequency, puff duration, inhalation depth, the smoker's metabolism, and the smoker's body weight.

Similarly, the purpose of the FTC testing is not to duplicate the smoking technique of an "average" smoker. As the FTC originally recognized, such an effort would be highly misleading:

> "There are too many variables as to both smokers and to smoking conditions for any average to be meaningful. Test results phrased in terms of an 'average' smoker could be misleading to the public because a smoker has no way of knowing how closely his smoking habits conform to those of the purportedly 'average' smoker." Id.

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Instead, the purpose of the FTC test is to "provide some objective basis for ranking the yields of cigarettes." Lynn T. Kozlowski, "Report on Barclay" (submitted to the FTC as part of the current investigation). Further, the FTC test is designed to be a standardized test. Thus, by definition it is not and cannot be perfectly correlated to the characteristics of any particular smoker or to any particular brand of cigarettes. The current FTC test fulfills its original purpose. It does accurately rank cigarettes according to tar and nicotine yields. Numerous scientific studies support this conclusion.

The first important study relevant to this issue was conducted by Dr. Gio Gori of the Franklin Research Institute. Dr. Gori compared cotinine levels in blood plasma resulting from the smoking of ultra-low tar and nicotine cigarettes. Gio B. Gori and Cornelius J. Lynch, "Analytical Nicotine Yields as Predictors of Smoker Intake From 1 mg Nominal FTC Tar Cigarettes" submitted to the FTC on February 12, 1981 (hereafter the "Gori Report"). Cotinine is the primary metabolic product of nicotine, and as such it is the best measure of the amount of nicotine actually absorbed into a smoker's body. Dr. Gori's cotinine study resulted in the same relative rankings with regard to nicotine as result from the current FTC testing procedure.

Other work by Gori shows that not only does cotinine analysis result in the same relative rankings as are indicated by

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the current FTC test, but cotinine analysis also results in the same ratios of tar and nicotine among ultra-low-yield cigarettes. See discussion of Gori's research in the Report of Dr. Gabriel L. Plaa and Dr. David P. Westfall attached hereto. Thus, Gori's work provides strong evidence that the FTC testing procedure is producing accurate results for Barclay and the other ultra-low-yield cigarettes.

Dr. Gori's results are reinforced by a pharmacokinetic study by Dr. T. D. Darby and James E. McNamee entitled "Review of Methods Used to Determine Nicotine Absorption" which already has been submitted to the FTC. Although this study did not result in the same nominal FTC nicotine yields, it did result in the same relative rankings as resulted from the FTC test.

In light of various technical criticisms which the FTC consultants leveled against the Gori and Darby research, Liggett approached two independent and extremely well respected experts in pharmacology, Professor Gabriel Plaa of the Faculty of Medicine, University of Montreal, and Professor David P. Westfall of the School of Medicine, University of Nevada, to review the data base and comment on the FTC consultants' criticisms. Dr. Plaa is a member and former chairman of the Department of Pharmacology, Faculty of Medicine, University of Montreal. He also is Vice-Dean for Research at the University of Montreal. He has written numerous articles on pharmacology, and he is on the editorial

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board of a number of journals, including the Journal of Pharmacology and Experimental Therapeutics. He has served as the President of the Pharmacological Society of Canada. Dr. Westfall is Chairman of the Pharmacology Department at the University of Nevada School of Medicine. The Report of Drs. Plaa and Westfall as well as their resumes are attached.

Drs. Plaa and Westfall conclude that plasma cotinine is currently the most reliable measure of human absorption of nicotine. They also conclude that the cotinine research by both Gori and Darby was properly conducted in accordance with established scientific procedures with adequate controls. Plaa and Westfall further found that the Gori and Darby research does support the conclusion that the current FTC testing methodology accurately places Barclay in the same category as Cambridge, Now and Carlton.

With respect to the FTC consultants' criticism that Gori and Darby should have included a high tar and nicotine yield cigarette in the sample, Plaa and Westfall believe that a high-yield sample was not necessary in order to assess the FTC's question of whether Barclay belongs in the ultra-low category. The research by both Gori and Darby showed remarkably similar cotinine yields from each of the cigarettes currently classified in the ultra-low category. Also of great significance is the finding by Plaa and Westfall that the ratios of cotinine yields

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between different brands were almost identical to the ratios of tar and nicotine between brands as indicated by the FTC testing procedure. This data strongly supports the conclusion that Barclay properly belongs in the same category as Now, Cambridge, and Carlton.

Even if a high-yield sample were to result in comparable cotinine yields as are produced by the low tar and nicotine cigarettes,*/ such a hypothetical finding would not mean that cotinine values for low-yield cigarettes are inaccurate. Indeed, such a finding could indicate the much more significant conclusion that high-yield cigaretes are not such a health hazard as the FTC now assumes.

The analysis by Drs. Plaa and Westfall also responds to concerns about an alleged "absence of a proven dose-response relationship between blood cotinine and FTC nicotine yields." E.g., see Report of M. Guerin (March 12, 1982). Drs. Plaa and Westfall found that a plotting of plasma cotinine levels versus

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*/ No reasonable scientific data supports the surmise that high-yield cigarettes will result in approximately the same cotinine values as are produced by low-yield cigarettes. The Hill and Marquardt study cited by FTC consultant Kozlowski involved only three subjects and even that unreliable sample showed higher cotinine values for nominally high-yield cigarettes than for nominally low-yield cigarettes.

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the number of cigarettes consumed does indeed establish a dose-response relationship. Moreover, Plaa and Westfall conclude that even such small differences as 0.1 mg. as measured by the FTC testing methodology result in significant and measurable differences in plasma cotinine levels.

Finally, the analysis by Plaa and Westfall indicates that smoking behavior does not disproportionately increase cotinine levels for Barclay smokers when compared to smokers of other low-yield brands. Had there been a systematic circumvention of the Barclay filter, a higher percentage of subjects in the Darby study would have exhibited significantly larger plasma cotinine values.

In short, the existing FTC testing methodology appears to accurately measure nicotine intake -- at least for nominally low-yield cigarettes. No cotinine research undertaken by anyone indicates to the contrary. Instead, we submit that the only basis which the FTC has for believing that Barclay is inaccurately ranked is the intuitive feeling that Barclay must have a higher tar and nicotine yield than the other ultra-low tar and nicotine cigarettes because (i) it tastes better and (ii) admittedly artificial, and thus unreliable, ventilation studies submitted to the FTC by Reynolds and Philip Morris suggest Barclay may be misclassified. Changes in the FTC testing methodology which could have profound adverse effects on competition should not

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be based on intuitive feelings or research proffered by the dominant competitors in the industry. Indeed, it would appear imperative that a federal regulatory agency charged with both consumer protection and competitive mandates should act in response to clear and reliable scientific evidence. Such scientific evidence does not now exist.

III. The Proposed Alterations to the FTC Test are Inequitable and Discriminatory.

The FTC currently is proposing to change a standardized test which by definition is not supposed to duplicate actual smoking behavior. Ironically, the basis for the FTC's proposed change is the mistaken belief that one form of perceived individual smoking behavior distorts the reported tar and nicotine levels in one type of cigarette. Based on what we believe can only be described as biased, self-serving research submitted by Philip Morris and Reynolds, the FTC appears to believe that smokers' lips occlude the exits on the Barclay filter and that Barclay smokers crush the filter, blocking the air-vent channels. However, careful research conducted by Roger D. Kamm of the Massachusetts Institute of Technology and submitted to the FTC conclusively shows that the current FTC cigarette holder closely approximates the pressure from human lips. Further, the FTC's independent consultant, Fred G. Bock, concluded in his "Report on the Appropriateness of FTC Tar and Nicotine Assays of

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Barclay Cigarettes" (March 16, 1982) that there is no evidence establishing that smokers actually crush Barclay filters and no evidence even indicating the extent to which smokers compress Barclay ventilation channels.

Even if there were some compression and occlusion of ventilation channels in Barclay filters, the effect on nicotine intake would be relatively insignificant when compared to the effect of smoking behavior on actual nicotine intake in other brands. Research conducted by Lynn Kozlowski (before he was retained by the FTC) indicates a significant amount of hole blocking by smokers of ultra-low tar and nicotine cigarettes. L. Kozlowski et al., "The Misuse of 'Less Hazardous' Cigarettes and Its Detection: Hole Blocking Ventilated Filters", 70 American Journal of Public Health 11, (1980). Professor Kozlowski reported, "[W]e have found in systematic interviews that 32 percent to 69 percent (95 percent confidence interval) of low-tar smokers have blocked the holes with their fingers, lip or with tape." Id.

However, the FTC proposals do not even attempt to confront the problem of hole-blocking and other forms of compensatory smoking. Rather, the FTC tries to distinguish Barclay from the other ultra-low tar and nicotine cigarettes on the ground that reduced ventilation in Barclay is "inevitable and cannot be avoided by the informed consumers. . . ." while hole blocking and compensatory smoking of other ultra low-tar and nicotine

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cigarettes can be avoided by an "informed" consumer. See FTC Determination Re Barclay Cigarettes (April 13, 1983).

Such a distinction is unsupportable. First, cigarettes such as Merit have invisible air ventilation holes so that even the most sophisticated smoker would have difficulty avoiding blockage of such holes. Second, cotinine research performed by Dr. Gori and described in the Report of Drs. Plaa and Westfall, indicates that Barclay smokers do not always absorb more nicotine than the FTC tests specify. Third, as a matter of reality, there are very, very few, if any, individuals who meet the FTC's hypothetical standard of an "informed consumer." As Lynn Kozlowski has noted:

> "Most of the individuals who misused the ventilated cigarettes in this way [hole blocking] were unaware that they were blocking the holes. So, lecturing to a group of smokers about this problem usually results in skepticism or denial rather than repentance and promises to do better." Lynn T. Kozlowski, "Applications of Some Physical Indicators Cigarettes Smoking", 6 Addictive Behaviors, 213-219 (1981).

Thus, even Kozlowski's research indicates that consumers simply cannot be educated with respect to hole blocking and compensatory smoking behavior.

Moreover, the FTC's hypothetical "informed consumer" inevitably would engage in other forms of unconscious compensatory smoking behavior in order to satisfy a taste for nicotine. It appears that smokers automatically adjust smoking habits to obtain

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some "optimum" nicotine level either by increasing the number of low tar and nicotine cigarettes they smoke or by increasing the depth and duration of their puffs. H. Ashton and D. W. Watson, "Puffing Frequency and Nicotine Intake in Cigarette Smokers," British Medical Journal, September 19, 1970. As Kozlowski has written, unconscious compensatory smoking behavior can take many forms:

> "It is especially important to realize that hole-blocking is only one form of compensatory smoking behavior. The fact that one does not block the holes does not also mean that one does not take more frequent, larger, deeper or longer inhalations from these cigarettes." Lynn T. Kozlowski, "Perceiving The Risks of Low-Yield Ventilated--Filter Cigarettes: The Problem Hole Blocking," presented at International Workshop on the Analysis of Actual vs. Perceived Risks, June 2, 1981.

In short, even assuming, arguendo, that smoking behavior is relevant to the performance of a standardized test, we do not believe the FTC has any direct evidence that the smoking behavior of consumers of Barclay causes them to inhale more tar and nicotine than does the smoking behavior of consumers of other ultra-low tar and nicotine cigarettes. Absent such proof, it would be unfair and inequitable to discriminate against Barclay while letting other ultra-low cigarettes manufactured by the market leaders continue to tout their purported advantages. Moreover, to change testing procedures in the absence of direct evidence that consumers of Barclay absorb more nicotine and tar

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than do consumers of other ultra-low brands would have serious competitive consequences to the firms in this industry who are trying to compete with Philip Morris and Reynolds. If the reason for the proposed changes were sound, one might well conclude that competitive factors were less important than consumer welfare. But as this clearly is not the case; there appear to be no sound reasons to change the FTC testing procedures.

IV. The FTC's Proposed Discrimination Against Barclay-Type Filters Will Have Many Unintended Harmful Effects on the Consumer.

Consumers and certainly consumer education would be injured in a number of respects if the FTC were to alter its testing methodology in response to what we believe to be slim, inconclusive evidence presented largely by Reynolds and Philip Morris. Although the FTC may have nonpublic information available that is arguably supportive, such information is not known to the respected pharmacologists whom we retained. Without a proper basis, the proposed changes would harm competition as well as inhibit consumers from switching to low tar and nicotine brands.

The proposed changes would harm competition and further entrench the substantial market power of Reynolds and Philip Morris. Every time the FTC testing methodology is changed, significant costs are imposed on cigarette manufacturers. Such costs fall disproportionately on the small manufacturers --

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particularly Liggett. Any change in the testing methodology (i) would cause Liggett to implement new quality control procedures to monitor its brands' performance under the new test, (ii) would require the complex reformulationn of each brand's particular blend of different types, grades, and seasonings of tobaccos, and (iii) would necessitate the possible relabeling of all brands. At the current time, Liggett produces over 160 separate brands of cigarettes for its own labels as well as for generic and private label customers. This is an incredible number of brands, a number probably much higher than the total number of brands marketed domestically by all domestic manufacturers.

Also, the marketing of existing brands would have to be reexamined at a significant cost to cigarette manufacturers. Even if the new test yielded the same relative tar and nicotine rankings as currently exist, any change in the absolute number would cause significant consumer confusion. Although the absolute numbers are meaningless by themselves, consumers have come to rely on the absolute numbers with which they are familiar.

To the extent that consumer confusion could not be ameliorated by expensive marketing campaigns, cigarette companies would have to alter the blends of their cigarettes in an effort to maintain the same absolute tar and nicotine numbers that are produced under the existing tests. Such an undertaking is

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incredibly difficult and very expensive, creating virtually insurmountable hardship to smaller manufacturers who in Liggett's case have only recently been able to gain consumer acceptance of their new blends. Indeed, the successful development of new blends is a process which takes years to accomplish. With so many different brands in the emerging generic and private label market, Liggett would face staggering obstacles. The net effect could be to choke off a competitive innovation in this industry in its infancy.

The proposed alterations of the FTC testing methodology would harm innovation in other respects as well. All but the most firmly entrenched firms would be reluctant to engage in any meaningful innovation. If the FTC demonstrates a willingness to change its testing methodology to cure relatively minor perceived problems with every innovation, no incentives for innovation would exist. Certainly, the threat of FTC meddling is real because no standardized test could yield perfect results when compared to particular product innovations. Thus, alteration of the FTC's test in response to the Barclay filter would send a message that the FTC intends to hold all innovations to impossible standards which are not applied to other brands. All of this, of course, in apparent response to the effort by the two major competitors working against the interests of a much smaller firm.

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By removing incentives for innovation and by imposing significant costs on the manufacturing of cigarettes, the FTC's proposed conduct of altering the FTC testing methodology also would serve to further entrench the dominate market positions of Philip Morris and Reynolds. As market leaders, these two companies already control approximately 70 percent of all industry sales and have strong incentives to go to great lengths to impede innovation by their rivals.

Indeed, we can only suggest what is obvious: Reynolds and Philip Morris did not initiate and orchestrate the FTC's current adventure for altruistic reasons. Instead, Reynolds' and Philip Morris' behavior is but another example of a continuing pattern of most questionable competitive conduct. After years of most successful and arguably restrictive marketing practices, the two giants in the industry are now seeking to kill two of the greatest innovations in cigarette manufacturing in this decade: new filter developments such as that introduced by Brown & Williamson and generic and private label cigarettes introduced by Liggett.

In addition to the anticompetitive implications of the proposed changes, the proposed changes could have unintended consequences on consumer health. If the FTC's inconclusive research is wrong and the Barclay filter does indeed provide improved taste with relatively low tar and nicotine yields, then the FTC's alterations would have inhibited thousands of

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individuals from converting from higher tar and nicotine yielding cigarettes to lower yielding Barclay or other cigarettes utilizing such filter technology.

V. The Proposed FTC "Remedies" are Worse Than the Perceived Problem.

Each of the proposed changes to the FTC testing methodology would create greater inaccuracies in measuring tar and nicotine yields and greater potential for misleading consumers than currently exists. For example, the most reliable study of the proposed Filtrona holder shows that it exerts nearly fifteen times as much pressure as is exerted by human lips. See Dr. Roger Kamm's Report, submitted to the FTC by Brown & Williamson. Likewise, the proposed alterations to the Cambridge holder would block exit channels on the Barclay filter in a highly artificial manner. Fiber optic research by Dr. Louis Fine confirms that the two proposed alterations to the current holder would severely exaggerate human smoking behavior and thereby result in distorted rankings of cigarette brands.

Even if the FTC were convinced that some change had to be made in the current FTC testing procedure, much more research would have to be undertaken before devising a new testing methodology. As Dr. Bock acknowledged in his report to the FTC, "[T]here is not sufficient evidence available to the Commission to select the most reliable and fair testing system . . . [and]

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the data do not indicate the best remedial action for the Commission to take."

If new testing methodology is to be adopted, it should not involve discriminatory tinkering with the cigarette holder. Rather, it should build upon innovative cotinine research. All the FTC consultants agree that the most reliable measure of tar and nicotine intake is cotinine analysis. Thus, any alteration to the current FTC testing methodology should await refined cotinine research measuring all brands of cigarettes. Such research would be the most accurate way to check whether any change in the current FTC test is needed as well as to determine the reliability of proposed changes. At the present time, there is simply no reliable scientific benchmark against which the current proposed changes can be measured for all brands of cigarettes.

Finally, in view of the distortions which smoking behavior create in tar and nicotine intake, perhaps the soundest alternative to the existing test would be the abolition of all testing of tar and nicotine content on the grounds that such testing is inherently misleading to an individual smoker. In the words of Lynn T. Kozlowski:

> "Although the words on cigarette packs and advertisements appear to indicate the dose of tar and nicotine to be found in a cigarette, smokers can easily double or triple yields beyond the nominal levels by

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> taking more frequent, larger, or higher velocity puffs. . . . Even the lowest-yield cigarettes in the market . . . can deliver two times as much nicotine, three times as much tar, and about four times as much carbon monoxide, if a smoker simply holds these ventilated-filter cigarettes three or four mm farther back in the mouth, thereby defeating the purpose of the vents with his or her lips. . . . Unless the low-yield brand leads to low-yield smoking . . . the smoker may be seriously mistaken about how much he or she is in control of the risks of cigarette smoking." L. Kozlowski, "Application of Some Physical Indicators of Cigarette Smoking", 6 Addictive Behaviors, 213-219 (1981).

Current research indicates that smoking behavior can seriously distort the tar and nicotine intake and that it would be virtually impossible to "educate" the consumer to change such smoking behavior. Id. Accordingly, a strong basis exists for abolishing all testing of tar and nicotine -- at least until further cotinine testing is undertaken. In any event, certainly a regulatory agency should have what leading experts suggest as "the minimum necessary" data in hand before embarking on testing changes which will leave the smaller firms dueling with phantoms in the dark as to future developments and the industry with fewer competitors.

In the meantime, although arguments could be made for imposing a general warning label on cigarettes informing smokers that smoking behavior can significantly affect tar and nicotine intake for all brands, such a label would appear to serve little

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purpose as a practical matter. There already exists a most severe warning on cigarette packages and even more severe warnings are under consideration by the Congress. But even this alternative would be preferable to a change in testing procedures before adequate additional research is completed.

VI. Conclusion

In conclusion, the current FTC testing methodology should not be changed. The most reliable tests indicate that the current FTC testing methodology yields the correct relative ranking of cigarettes by tar and nicotine. None of the proposed testing alterations would improve the accuracy of the existing test with regard to relative rankings. At the same time, changing the testing methodology would cause significant consumer confusion and skepticism regarding FTC tests, discourage innovation, and further entrench the market power of the two dominant powers in the industry.

No standardized test will be perfect. And because of the serious consequences of altering a standardized test, such alterations should only be made if clear, reliable scientific data demonstrate that the alterations would significantly improve the accuracy of tar and nicotine results across a broad spectrum of brands. No such data now exist. Thus, to change the test now would be to put the cart before the horse, while at

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the same time seriously handicapping competitive innovation and product development in the cigarette industry.

Because of the importance of these issues, we hereby request an opportunity to present our views orally to the Commission and its staff. We would respectfully suggest that the Commission proceed only after oral hearings on this subject either before the full Commission or a designated Administrative Law Judge.

Respectfully submitted,

Lawrence G. Meyer

Lawrence G. Meyer
Garret G. Rasmussen

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62

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REPORT TO THE FEDERAL TRADE COMMISSION ON FTC CIGARETTE METHODOLOGY

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and

David P. Westfall, Ph.D.
University of Nevada

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REPORT TO THE FEDERAL TRADE COMMISSION
ON FTC CIGARETTE METHODOLOGY

We have been asked by counsel for Liggett & Myers Tobacco Company, Inc. to render a scientific opinion as pharmacologists concerning the validity of the current FTC testing procedure for indicating the likely range of tar and nicotine yield from "low yield" cigarettes. Our opinion is based on a review of the following reports: "Pharmacokinetics of Nicotine and Cotinine" by Drs. Van Rossum and Darby (Dec. 7, 1982); "Smoker Intake from Cigarettes in the 1 Mg. Tar Class" by Drs. Gori and Lynch (Dec. 7, 1982); "Comparison of Human Uptake Among Cigarette Brands Rated as One Milligram Tar Yield" by Drs. Darby, McNamee and Van Rossum (Dec. 7, 1982); and the FTC consultant reports by Dr. Guerin, "Letter to Mr. Andrew Sachs" (March 12, 1982); Dr. Bock, "Report on the Appropriateness of FTC Tar and Nicotine Assays of Barclay Cigarettes" (March 16, 1982); and Dr. Kozlowski, "Report on Barclay" (not dated).

The three FTC consultant reports suggest that the current FTC test underestimates the yield from one brand, Barclay, and the reports pose some questions relative to the data reviewed. However, it appears to us that the consultant reports may be based on a preliminary version of the data base. For example, Dr. Kozlowski refers to 12 subjects in a cotinine study by Gori, whereas the data reviewed involved a much larger population, e.g., 238 subjects. Indeed, many of the concerns which the FTC consultants expressed about the data base should no longer be concerns in light of the updated materials we reviewed.

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There seems to be little dispute among the interested parties that, of currently available approaches, plasma cotinine levels provide the most accurate indication of nicotine uptake. Specific points that we wish to make concerning the plasma cotinine data are detailed below.

1. The use of plasma cotinine as a measure of human uptake of nicotine is based on sound pharmacological principles. The report of Van Rossum and Darby details the reasoning and explains accurately the pharmacokinetics of nicotine and cotinine. Their report details the relationship between plasma cotinine and cigarette-yield and provides for variations in inter-individual smoking behavior.

2. The data reported by Gori and Lynch were obtained from well formulated pharmacological studies with human subjects. The sample size (over 200 subjects) and "cross-over" design afford a high degree of control over subject-dependent variables. Based on our familiarity with pharmacological approaches, the sample size and cross-over design are commensurate with established procedures for assessing the effects of pharmacological agents. Specifically, the investigators insured by the design of their studies that plasma cotinine levels were at steady-state conditions. Additionally, it is noteworthy that sampling was uniform in terms of time of day, which again insures the validity of their methods. The design, therefore, permits one to draw conclusions regarding the average response of the population being tested.

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The Gori and Lynch data, normalized on the basis of cigarette consumption, show that Brand B (Carlton) and Brand C (Cambridge) did not differ from each other in terms of plasma cotinine levels and that Brand A (Barclay) yielded higher plasma cotinine levels. When we calculate the ratio of Brands A/B and A/C, based on information in Table 6 of the Gori and Lynch paper, the values indicate that subjects smoking Brand A had a normalized plasma cotinine which was 1.58 times higher than subjects smoking Brand B and 1.61 times higher than subjects smoking Brand C. The investigators also provided the nicotine content of the three brands used in the study. These contents were determined by the FTC standardized test. A comparison of the nicotine content of the test cigarettes indicates that Brands B and C were virtually identical whereas Brand A contained 1.8 times more nicotine than Brand B and 1.64 times more nicotine than Brand C. Thus, the ratios obtained in human subjects smoking the three brands yielded plasma cotinine ratios that were virtually identical to the nicotine content ratios of the cigarettes under current FTC testing procedures. Thus, the plasma cotinine level studies demonstrate that cotinine levels can be used to distinguish Barclay from the other two brands. The studies further showed that Brands B and C could not be distinguished from each other. Importantly, the cotinine results parallel the differences observed in nicotine yields by the FTC test procedure.

In summary, claims have been made that the Barclay delivers much larger nicotine and tar values than the FTC test predicts.

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However, the Gori and Lynch studies do not support this contention and further demonstrate that the deliveries measured by the FTC procedure agree quite well with the values determined by the sensitive cotinine level method.

3. There seems to be little doubt that individual smokers can subvert the filtration system of low yield cigarettes such that there can be a substantial increase in nicotine yield. It is the contention of those who seek a change in the FTC testing procedure that this is a significantly greater problem for the Barclay brand of low tar cigarette. The data of the report by Darby, McNamee and Van Rossum (figures 6 and 7), however, to not bear this out. The curve relating the log plasma cotinine concentration to the percent of the population is shifted in parallel to the right for the Barclay smokers in comparison to the other brands. The parallel shift to the right suggests that a systematic circumvention of the Barclay filter did not occur. Had there been a systematic circumvention of the Barclay filter, one would expect a higher percentage of the subjects to exhibit larger (i.e., greater than 1.6 to 1.8-fold) plasma cotinine values.

4. The report by Dr. Kozlowski expresses amazement that plasma cotinine levels would differ (as shown by the Darby, et al. data) among subjects smoking a nominally 0.1 mg nicotine brand (e.g., Cambridge/ Carlton) and a nominally 0.2 mg nicotine brand (e.g., Barclay). Dr. Kozlowski points out that this is

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even more surprising since the nicotine values are actually 0.11 mg and 0.15 mg for the Cambridge and Barclay brands respectively. Thus, there is skepticism concerning the relationship between the FTC nicotine yields and the plasma cotinine levels. However, it is important to realize the the FTC yield of the Barclay brand, even using Dr. Kozlowski's figures, is nevertheless 36% greater than the Cambridge brand. From a pharmacological perspective, a 36% larger "dose" is not trivial, and it seems not unexpected to us that this difference would be reflected in the plasma cotinine levels.

Further, figure 4 of the Gori and Lynch study indicates that a dose-response relationship does indeed exist. The plot of plasma cotinine level (i.e., the response) versus the number of cigarettes consumed per day (i.e., the dose) indicates that differences in dose of about 25% yield discernably different plasma cotinine levels. An even better evaluation regarding the specific sensitivity of the cotinine test would be to measure plasma cotinine in response to intravenous nicotine administration.

5. One of the FTC consultants maintains that the Gori/Darby data relative to plasma cotinine levels do not definitively show whether the Barclay brand is more similar to other low-yield brands or to higher yield brands since data with higher yield brands are not available. The implication is that Barclay may be more similar to high yield brands. We are unaware of any data that address this point. In our opinion, the data do

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show that with the three low yield brands, the plasma cotinine levels are entirely consistent with the relative rank order as determined by the FTC test, since the brand ratios obtained in each test are virtually identical (see No. 2). To recommend a change in the FTC test because of a supposition which is unsupported by data, seems to us to be inappropriate.

We are of the opinion that plasma cotinine levels from "high" and "low" yield brands should be obtained before the FTC testing methodology is altered. These data are necessary to determine if the FTC yield test is an adequate predictor of nicotine intake by smokers of all brands as it appears to be for the three low yield cigarettes used in the Gori and Lynch study. Such plasma cotinine levels would become the reference base to which the FTC testing procedure could be compared. This information is necessary in order to determine whether a change in the FTC test is needed.

In conclusion, we believe that potential delivery of nicotine by low-yield cigarettes is correctly ranked by the current FTC test. If there is a problem with the rankings, it appears to be related to individual smoking behavior and not to the yield of the cigarette per se. With specific reference to the Barclay brand, based on plasma cotinine data, abuse of the filtration system seems to be no greater than with other brands tested by Gori and Lynch.

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CURRICULUM VITAE

Gabriel L. Plaa, Ph.D.

Professor

Department of Pharmacology, Faculty of Medicine
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Vice-Dean for Medical Research & Graduate Studies
University of Montreal

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REFERENCES

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UNIVERSITY EDUCATION

1952 B.Sc.	University of California (major: Criminalistics).
1956 M.Sc.	University of California (major: Comparative Pharmacology and Toxicology).
1958 Ph.D.	University of California (major: Comparative Pharmacology and Toxicology).

PROFESSIONAL CERTIFICATION

1981	Diplomate, American Board of Toxicology.
1983	Diplomate, Academy of Toxicological Sciences.

ACADEMIC APPOINTMENTS

1954-58	Teaching and Research Assistant, Department of Pharmacology, University of California, School of Medicine.
1958-60	Instructor, Department of Pharmacology, Tulane University School of Medicine.
1960-62	Assistant Professor, Department of Pharmacology, Tulane University School of Medicine.
1962-63	Assistant Professor, Department of Pharmacology, College of Medicine, State University of Iowa.
1963-68	Associate Professor, Department of Pharmacology, College of Medicine, State University of Iowa.
1968-	Professor, Department of Pharmacology, Faculty of Medicine Universite de Montreal.
1968-80	Chairman, Department of Pharmacology, Faculty of Medicine, Universite de Montreal.
1979-82	Vice-Dean for Research, Faculty of Graduate Studies, Universite de Montreal.
1982-	Vice-Dean for Medical Research & Graduate Studies, Faculty of Medicine, Universite de Montreal.

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PROFESSIONAL EMPLOYMENT

1954-58	Assistant Toxicologist (Part Time), Coroner's Office of the City County of San Francisco.

NATIONAL AND INTERNATIONAL COMMITTEES

1964-65	Chairman, Educational Committee of the Society of Toxicology.
1965-69	Toxicology Study Section, Division of Research Grants, National Institutes of Health, USPHS. Chairman, 1967-69.
1966-67	Committee on Recuirtment Methods, Society of Toxicology.
1967-71	Program Committee, American Society for Pharmacology and Experimental Therapeutics. Chairman, 1969-71.
1968-69	Program Committee, Society of Toxicology.
1968-75	Committee on Scholars, Medical Research Council of Canada. Chairman, 1973-75.
1970-71	Grants Committee for Physiology and Pharmacology, Medical Research Council of Canada.
1970-72	Committee on Problems of Drug Safety, National Academy of Sciences, National Research Council (USA).
1971-75	Pharmacology-Toxicology Program Committee, National Institute of General Medical Sciences, National Institutes of Health, USPHS.
1972-82	Select Committee on GRAS Substances, Life Science Research Organization, Federation of American Societies for Experimental Biology.
1976-81	Expert Advisory Panel on Food Additives and Contaminants, World Health Organization.
1977-81	Environmental Toxicology Advisory Panel, (Strategic Grants), Natural Sciences and Engineering Research Council of Canada. Chairman, 1980-81.
1978-81	International Advisory Board, International Union of Pharmacology.

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EDITORIAL BOARDS

1963-68	Editorial Board, Toxicology and Applied Pharmacology.
1965-70	Editorial Board, Journal of Pharmacology and Experimental Therapeutics.
1967-	Editorial Board, Essays in Toxicology.
1968-72	Associate Editor, Toxicology and Applied Pharmacology.
1968-74	Associate Editor, Canadian Journal of Physiology and Pharmacology.
1969-77	Editorial Board, Agents and Actions.
1970-72	Field Editor for Toxicology, Journal of Pharmacology and Experimental Therapeutics.
1972-80	Editor, Toxicology and Applied Pharmacology.
1973-	Honorary Advisory Board, Biochemical Pharmacology.
1976-	Editorial Board, Proceedings of the Society for Experimental Biology and Medicine.
1977-	Advisory Editorial Board, Archives Internationales de Pharmacodynamie et de Therapie.
1977-	Editorial Board, Toxicology Letters.
1978-	Advisory Editorial Board, Trends in Pharmacological Sciences.
1982-	Editorial Board, Annual Review of Pharmacology and Toxicology.

SOCIETY OFFICES

1970-72	Councillor, Pharmacological Society of Canada.
1972-73	Councillor, Society of Toxicology (U.S.A.).
1972-73	Vice-President, Pharmacological Society of Canada.
1973-74	President, Pharmacological Society of Canada.
1974-77	Councillor, Society for Experimental Biology and Medicine.

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SOCIETY OFFICES (cont'd)

1976-79	Executive Committee, Canadian Association for Research in Toxicology.
1978-81	Vice-Chairman, Section on Toxicology, International Union of Pharmacology.
1979-81	Vice-President, Society of Toxicology of Canada.
1980-	Director, International Union of Toxicology.
1981-82	Vice-President-elect, Society of Toxicology (U.S.A.).
1981-	President, Society of Toxicology of Canada.
1981-	Chairman, Section on Toxicology, International Union of Pharmacology.
1981-83	Vice-President, Society of Toxicology (U.S.A.).
1983-	President, Society of Toxicology (U.S.A.).

UNIVERSITY COMMITTEES

1963-68	Medical Education Committee, University of Iowa.
1964-65	Basic Science Building Committee, University of Iowa.
1967-68	Hospital Policy Board, University of Iowa.
1968-80	Committee on Research and Graduate Degrees, Faculty of Medicine, Universite de Montreal.
1968-73	University Commission on Graduate Degrees, Universitie de Montreal.
1969-80	Committee on Research and Graduate Degrees, Faculty of Medicine, Universite de Montreal.
1969-72	University Committee on Research, Universite de Montreal.
1970-73	Council, Faculty of Medicine, Universite de Montreal.
1970-75	University Committee on Promotions, Universite de Montreal.

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UNIVERSITY COMMITTEES (cont'd)

1973-	Council, Faculty of Graduate Studies, Universite de Montreal.
1975-78	Council, Faculty of Medicine, Universite de Montreal.

HONORS

1967	Achievement Award, Society of Toxicology (U.S.A.).
1969	Henderson Memorial Lecturer, Canadian Association for Research in Toxicology.
1971	Claude Bernard Medal, Institute of Experimental Medicine and Surgery, Universite de Montreal.
1977	Clinton H. Thienes Memorial Award, American Academy of Clinical Toxicology.
1981	Arnold J. Lehman Award, Society of Toxicology (U.S.A.).
1981	Commemorative Medal, Sinshu University School of Medicine (Japan).

PROFESSIONAL SOCIETIES

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77

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CURRICULUM VITAE

:vid Patrick Westfall

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EDUCATION::

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University:	A.B. (Biology) Brown University	1964
	M.S. (Pharmacology) West Virginia University	1966
	Ph.D. (Pharmacology) West Virginia University	1968

AWARDS:

1960-1964	Scholarship from Brown University
1964-1968	United States Public Health Service Predoctoral Fellowship in Pharmacology
1968-1969	J. H. Burn Postdoctoral Fellowship, Oxford University
1971, 1975	Co-recipient, MacLachlan Award for Excellence in Teaching in Basic Medical Science
1975	West Virginia University "Outstanding Teacher Award"
1977	Swiss National Research Council International Fellowships, Basel, Switzerland

POSTDOCTORAL/SABBATICAL TRAINING::

1968-1969	Dr. Edith Bülbring, Professor of Pharmacology, Oxford University, Oxford, England
1977	Dr. Hans Thoenen, Professor of Pharmacology, Biocenter of the University of Basel, Basel, Switzerland

ACADEMIC APPOINTMENTS:

1968-1969	Demonstrator in Pharmacology, Oxford University Oxford England
1970-1973	Assistant Professor of Pharmacology, West Virginia University Medical Center, Morgantown, WV
1973-1977	Associate Professor of Pharmacology, West Virginia University Medical Center, Morgantown, WV
1977-1982	Professor of Pharmacology, West Virginia University Medical Center, Morgantown, WV
1982-present	Professor and Chairman, Department of Pharmacology University of Nevada School of Medicine, Reno, NV

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78

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SOCIETY MEMBERSHIPS:

American Society for Pharmacology and Experimental Therapeutics
Society for Neuroscience
Sigma Xi
American Association for the Advancement of Science

PROFESSIONAL, ADMINISTRATIVE AND COMMITTEE DUTIES:

1970-1975	Reviewer, Journal of Pharmacology & Experimental Therapeutics
1971-1973	Interviewer for WVU Medical School Admissions Committee
1972-1975	West Virginia University Faculty Senate (by election)
1972-1973	Member, Senate Committee on Research, Research Grants and Publications (by appointment)
1973-1982	Lecturer, West Virginia State Continuing Education Program in Pharmacology
1973-1974	Chairman, WVU Senate Committee on Research, Research Grants and Publications
1974-1976	Chairman, WVU Medical School Basic Science Committee on Faculty Travel and Medical Education Lectures
1975-	Member, Editorial Advisory Board, Journal of Pharmacology and Experimental Therapeutics
1976-1977	Member Nominating Committee of the American Society for Pharmacology and Experimental Therapeutics (by election)
1974-1978	Reviewer, European Journal of Pharmacology
1979-	Member, Editorial Advisory Board, European Journal of Pharmacology
1977-1979	Member, WVU Medical School Educational Program Committee
1977-1978	Member, WVU Medical School Faculty Promotion and Tenure Committee
1978-1979	Member, WVU Medical Student Research Committee
1978-1982	Chairman, Department Faculty Promotion and Tenure Committee
1978	Ad Hoc Study Section, National Heart, Lung and Blood Institute, NIH
1979-1982	Course Director, Pharmacology for Medical Students, WVU Medical School
1980	Program Project Site Visit Team, Neurology B, National Institute of Neurological Communicative Diseases and Stroke, NIH
1980	Member, Search Committee for Chairman, Ob-Gyn, WVU Medical School
1981-1984	Member, Long Range Planning Committee of the American Society for Pharmacology and Experimental Therapeutics
1981-1982	Member, WVU Department of Medicine Academic Review Committee
1981-1982	Chairman, Federation of American Societies for Experimental Biology and Medicine Summer Research Conference on Smooth Muscle

2023093965

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RESEARCH GRANTS

Role	Period	Source and Title
o-Investigator	9/68-12/69	MRC, United Kingdom Pharmacology and Physiology of Smooth Muscle
o-Investigator	11/70-12/73	NINDS; NIH Mechanism of Supersensitivity of Drugs
o-Principal nvestigator	1/74-12/78	NINDS; NIH Mechanism of Nonspecific Supersensitivity to Drugs
rincipal nvestigator	1971	Institutional Research Grant; WVU The Effect of Cocaine on Smooth Muscle Responses
rincipal nvestigator	1/73-12/75	NIEHS; NIH Tolerance to Cholinesterase Inhibitors
o-Investigator	11/75-12/76	Institutional Research Grant; WVU The Fine Structure of the Smooth Muscle of the Rat Vas Deferens: Effects of Fixation and Drug Treatment on the Appearance and Number of Nexuses
o-Investigator	7/76-6/77	American Heart Association, West Virginia Affiliate Ca^{++} Transport in Supersensitive Aortic Smooth Muscle
o-Investigator	7/76-6/77	American Heart Association, West Virginia Affiliate Electrophysiology of Supersensitive Cardiac Pacemaker
o-Investigator	4/78-9/81	Institutional Research Grant; WVU Neuropharmacology of Smooth Muscle of the Vas Deferens and Bladder
o-Principal nvestigator	1/79-12/81	NINCDS, NIH Mechanism of Nonspecific Supersensitivity to Drugs
o-Investigator	7/81-6/82	American Heart Association, West Virginia Affiliate Ionic/Neural Changes in the Cardiomyopathic Hamster
o-Principal nvestigator	1/82-12/85	NINCDS, NIH Mechanism of Nonspecific Supersensitivity to Drugs

2023093966

60

SEMINARS BY INVITATION AT OTHER INSTITUTIONS

niversity of Virginia Medical School harlottesville, VA	1971,1973
emorial University Medical School t. Johns, Newfoundland	1974
niversity of Massachusetts Medical School orcester, MA	1974
niversity of Texas Medical School an Antonio, TX	1975
outhern Illinois Medical School pringfield, IL	1976
ational Institutes of Health aboratory of Neuropharmacology ashington, DC	1976
offman-LaRoche Co., Inc. asel, Switzerland	1977
niversity of Würzburg ürzburg, Germany	1977
xford University xford, England	1977
t. Louis University Medical School t. Louis, MO	1980
outhern Illinois Medical School pringfield, IL	1981
niversity of Nevada School of Medicine eno, NV	1981
niversity of Pittsburgh School of Pharmacy ittsburgh, PA	1981

2023093967

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SESSIONS CHAIRED AT SCIENTIFIC MEETINGS

ession on Adrenergic Pharmacology ederation Meetings, Atlantic City, NJ	1974
ession on Smooth Muscle ixth International Congress of Pharmacology elsinki, Finland	1975
ession on Cardiac Receptors ardiovascular Satellite Meeting end, Oregon	1979
ession on Adrenergic Pharmacology merican Society for Pharmacology nd Experimental Therapeutics ochester, MN	1980
ession on New Drugs and Vasoactive Substances ourth International Symposium on Vascular euroeffector Mechanism yoto, Japan	1981

POSTDOCTORAL AND SABBATICAL INVESTIGATORS

(supervisor or co-supervisor)

r. Sergio de Moraes

r. Katsutoshi Goto

r. Jeffrey S. Fedan

r. Stephen Johnson

r. Penelope A. Longhurst

Dr. Stanley K. Wong

Dr. Peter Sneddon

Dr. Frederick F. Cowan, Jr.

Dr. Regina Markus

2023093968

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RREDOCTORAL STUDENT THESIS COMMITTEES

(*denotes thesis advisor)

ame	Major
Tony J. -F. Lee	Pharmacology
David A. Taylor	Pharmacology
William T. Gerthoffer	Pharmacology
ennis Foley	Pharmacology
ames M. Rowe	Pharmacology
. Andrew Zepp	Pharmacology
illiam V. Judy	Physiology & Biophysics
incent Castranova	Physiology & Biophysics
. Clark Lantz	Physiology & Biophysics
erry Farley	Physiology & Biophysics
elle Cimbala	Biochemistry
oy Fogwell	Reproductive Physiology
eter Abel	Pharmacology
Theodore Torphy	Pharmacology
Blanche Levitt	Pharmacology
John Schulz	Pharmacology
teve Ross	Pharmacology
oyce Kille	Physiology
. Kurt Hogaboom	Pharmacology
ozanne Barone	Pharmacology

2023093969

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INVITED SYMPOSIA LECTURES

:orphological and biochemical changes in supersensitive smooth muscle t the Symposium on Supersensitivity in Smooth Muscle, Federation :eetings, April, 1974.

'hanges in effector sensitivity not mediated by receptor alterations t the Neurosciences Research Program Work Session on Mechanism of .egulation of Neuronal Sensitivity, May, 1978.

'hysiological changes in responsiveness to catecholamines at the .ymposium on Tachyphylaxis to Catecholamines, ASPET Meetings, August, 978.

ne role of purines in autonomic neurotransmission, at the annual :eeting of the Research Discussion Group, Atlanta, GA, April, 1981.

ne use of arylazido aminopropionyl ATP, a new ATP antagonist, to dentify the role of purines in neuronal transmission, at the atellite meeting of the 8th International Congress of Pharmacology ntitled Vascular Neuroeffector Mechanisms, Kyoto, Japan, July, 1981.

BOOK CHAPTERS

:estfall, D.P. (1981) Supersensitivity of smooth muscle. In Smooth Muscle: An Assessment of Current Knowledge, eds. E. Bülbring, A.F. Brading, A. W. Jones and T. Tomita. pp 285-309. Edward Arnold

'harmacological Treatment of Hypertension in Modern Pharmacology, eds. C.R. Craig and R.E. Stitzel, Little, Brown and Co., Boston, 1982.

dmenoceptor Blocking Drugs in Modern Pharmacology, eds. C.R. Craig and R.E. Stitzel, Little, Brown and Co., Boston, 1982.

'ostjunctional Supersensitivity (with W.W. Fleming) in Handbook of Experimental Pharmacology, Volume "Catecholamines II, eds. U. Trendelenburg and N. Weiner, Springer-Verlag, Berlin, in press.

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ications:

estfall, D.P. and W.W. Fleming (1968). Sensitivity changes in the dog heart to norepinephrine, calcium and aminophylline resulting from pretreatment with reserpine. J. Pharmacol. Exp. Ther. 159:98-106

tahl, P.D., R.A. Gillis, D.P. Westfall adn A.D. Kenny (1968). Thyrocalcitonin in the dog heart-lung preparation: serum calcium and phosphorus responses. Life Sciences 7:1105-1110.

Westfall, D.P. and W.W. Fleming (1968). The sensitivity of the guinea-pig pacemaker to norepinephrine and calcium after pretreatment with reserpine. J. Pharmacol. Exp. Ther. 164:259-269

Westfall, D.P., P.E. Gilbert and W.W. Fleming (1969). Tension-response relationships in the intact nictitating membrane of the pithed cat. J. Pharmacol. Exp. Ther. 169:196-200.

Westfall, D.P. (1970). Nonspecific supersensitivity of the guinea-pig vas deferens produced by decentralization and reserpine treatment. Brit. J. Pharmacol 39:110-120.

Westfall, D.P. (1970). The effect of reserpine treatment and decentralization on the ion distribution in the vas deferens of the guinea-pig. Brit. J. Pharmacol 39:121-127.

Westfall, D.P., D.C. McClure and W.W. Fleming (1972). The effects of denervation, decentralization and cocaine on the response of the smooth muscle of the guinea-pig vas deferens to various drugs. J. Pharmacol. Exp. Ther. 181:328-338.

Fleming, W.W., D.P. Westfall, I.S. de la Lande and L. Jellett (1972). Log-normal distribution of equieffective doses of norepinephrine and acetylcholine in several tissues. J. Pharmacol. Exp. Ther. 181:339-345.

Westfall, D.P., D.A. Taylor and W.W. Fleming (1972). The effect of cocaine on the relative chronotropic potencies of sympathomimetics. Proc. Soc. Exp. Biol. Med. 141:363-366.

Fleming, W.W., J.J. McPhillips, and D.P. Westfall (1973). Postjunctional supersensitivity and subsensitivity of excitable tissues to drugs. Ergebnisse der Physiologie (Reviews of Physiology) 68:55-119.

Westfall, D.P. (1973). Antagonism by protriptyline and desipramine of the response of the vas deferens of the rat to norepinephrien, acetylcholine and potassium. J. Pharmacol. Exp. Ther. 185:540-550.

Westfall, D.P., J.J. McPhillips and D.J. Foley (1974). Inhibition of cholinesterase activity after postganglionic denervation of the rat vas deferens: Evidence for prejunctional supersensitivity to acetylcholine. J. Pharmacol. Exp. Ther. 189:493-498.

2023093971

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...or, D.A., D.P. Westfall and W.W. Fleming (1974). The effect of reserpine treatment on the chronotropic and inotropic sensitivities of the perfused guinea-pig heart to norepinephrine and calcium. Europ. J. Pharmacol. 29:102-108.

...ee, T.J.-F., D.P. Westfall and W.W. Fleming (1975). The correlation between spontaneous contractions and postjunctional supersensitivity of the smooth muscle of the rat vas deferens. J. Pharmacol. Exp. Ther. 192:136-148.

...leming, W.W. and D.P. Westfall (1975). Altered resting membrane potential in the supersensitive vas deferens of the guinea-pig. J. Pharmacol. Exp. Ther. 192:381-389.

...leming, W.W., P.R. Urquilla, D.A. Taylor and D.P. Westfall (1975). Electrophysiological correlations with postjuctional supersensitivity. Fed. Proc. 34:1981-1984.

...estfall, D.P., T.J.-F. Lee and R.E. Stitzel (1975). Morphological and biochemical changes in supersensitive smooth muscle. Fed. Proc. 34:1985-1989.

...estfall, D.P., and J.S. Fedan (1975). The effect of pretreatment with 6-hydroxydopamine on the norepinephrine concentration and sensitivity of the rat vas deferens. Europ. J. Pharmacol. 33:413-417.

...enedella, R.J., W.G. Crouthamel, G.G. Bierkamper and D.P. Westfall (1975). Alteration of drug pharmacodynamics by hyperlipidemia. Arch. int. Pharmacoldyn. 218:199-311.

...estfall, D.P., K. Goto, R.E. Stitzel, J.S. Fedan and W.W. Fleming (1975). Effects of various denervation techniques on the ATP of the rat vas deferens. Europ. J. Pharmacol. 34:397-400.

...leming, W.W., P.R. Urquilla and D.P. Westfall (1975). Membrane potential and supersensitivity in the vas deferens. In Chemical Tools in Catecholamine Research. Vol. II eds. O. Almgren, A. Carlsson and J. Engle. P. 107-109. North-Holland Publishing Co.

...owe, J.N., K. VanDyke, D.P. Westfall and R.E. Stitzel (1976). The effect of denervation upon the in vitro incorporation of adenosine-8-^{3}H into ^{3}H-adenine nucleotides in the guinea-pig vas deferens. Pharmacology. 14:193-204.

...aylor, D.A., D.P. Westfall, S. deMoraes and W. W. Fleming (1976). The effect of pretreatment with reserpine on the diastolic potential of guinea-pig atrial cells. Nauyn-Schmiedelberg's Arch. Pharmacol. 293:81-87.

...oto, K., L. L. Millechia, D.P. Westfall and W.W. Fleming (1977). A comparison of the electrical properties and morphological characteristics of the smooth muscle of the rat and guinea-pig vas deferens. Pflugers Arch. 368:253-261.

2023093972

Westfall, D.P., L.L. Millechia, T.J.-F. Lee, S.P. Corey, D.J. Smith and W.W. Fleming (1977). Effects of denervation and reserpine on nexuses in the rat vas deferens. Europ. J. Pharmacol. 41:239-242.

Westfall, D.P. (1977). The effects of denervation, cocaine, 6-hydroxydopamine and reserpine on the characteristics of drug-induced contractions of the depolarized smooth muscle of the rat and guinea-pig vas deferens. J. Pharmacol. Exp. Ther. 201:267-275.

Johnson, S.M., D.P. Westfall, S.A. Howard and W.W. Fleming (1978). Sensitivities of the isolated ileal longitudinal smooth muscle-mysenteric plexus and hypogastric nerve vas deferens of the guinea pig following chronic morphine pellet implantation. J. Pharmacol. Exp. Ther. 204: 54-66.

Goto, K., D.P. Westfall and W.W. Fleming (1978). Denervation-induced changes in electrophysiologic parameters of the smooth muscle of the guinea-pig and rat vas deferens. J. Pharmacol. Exp. Ther. 204:325-333.

Westfall, D.P., R.E. Stitzel and J.N. Rowe (1978). The postjunctional effects and neural release of purine compounds in the guinea-pig vas deferens. Europ. J. Pharmacol. 50:27-38.

Urquilla, P.R., D.P. Westfall, K. Goto and W.W. Fleming (1978). The effects of ouabain and alterations in potassium concentration on the sensitivity to drugs and the membrane potential of the smooth muscle of the guinea-pig and rat vas deferens. J. Pharmacol. Exp. Ther. 207:347-355.

Fedan, J.S., D.P. Westfall and W.W. Fleming (1978). Species differences in sodium-potassium adenosine triphosphatase activity in the smooth muscle of guinea-pig and rat vasa deferentia. J. Pharmacol. Exp. Ther. 207:356-363.

Bertholfer, W.T., J.S. Fedan, D.P. Westfall, K. Goto and W.W. Fleming (1979). Involvement of the sodium-potassium pump in the mechanism of postjuctional supersensitivity of the vas deferens of the guinea pig. J. Pharmacol. Exp. Ther. 210:27-36.

Fedan, J.S., D.P. Westfall and W.W. Fleming (1980). Potentiation by supernatant of Ca^{2+} uptake in rabbit aortic microsomes: effect of pretreatment of animals with reserpine. Life Sciences 26:469-474.

Fleming, W.W., P.W. Abel, P.R. Urquilla and D.P. Westfall (1980). Electrophysiologic correlations with supersensitivity in vascular smooth muscle: A minireview. In Vascular Neuroeffector Mechanisms. ed. J.A. Bevan et. al. pp. 123-128. Raven Press.

Fedan, J.S., G.K. Hogaboom, J.R. O'Donnell, J. Colby and D.P. Westfall (1981). Contribution by purines to the neurogenic response of the vas deferens of the guinea-pig. Europ. J. Pharmacol. 69:41-53.

Abel, P.W., P.R. Urquilla, K. Goto, D.P. Westfall, R.L. Robinson and W.W. Fleming (1981). Chronic reserpine treatment alters sensitivity and membrane potential of the rabbit saphenous artery. J. Pharmacol. Exp. Ther. 217: 430-439.

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